SUMMARIES OF CURRENT NORTH AMERICAN PRE-CAMBRIAN LITERATURE.[1]

DAVIS,[2] in connection with an account of the Triassic formation of Connecticut, maps the boundary between the Triassic and crystalline rocks to the east and west. The prevailing monoclinal faulted structure in the Triassic involves a similar structure in the crystallines below, and it is believed that the structure observed in the Triassic is due to the slipping of large slabs of the crystalline rocks and the overlying Triassic rocks, in such way that each slab was elevated with reference to the slab next to the west, or, lowered with reference to the one next to the east. The explanation of the cause of the faulted structure is the same as that offered in a previous paper.[3]

Merrill[4] gives a general account of the geology of the crystalline rocks of southeastern New York.

The crystalline rocks lie on the east of the Hudson River, in New York, Westchester, Putnam, and Dutchess counties, whence they extend into Connecticut; and on the west of the river, in Orange and Rockland counties, whence they extend southwesterly into New Jersey. The lowest member is a coarse hornblende-granite which forms the central mass of the range of mountains known as the Highlands of the Hudson, and, in their highest peak, Breakneck Mountain, is exposed through a vertical height of nearly 1200 feet. Other granites, nearly free from hornblende, occur in subordinate masses. The granites are probably igneous and of great age. On their flanks are banded gneisses, the Fordham Gneiss, consisting chiefly of quartz and orthoclase, with biotite and hornblende, and containing numerous beds of magnetic iron-ore. The gneisses on the south side of the Highlands extend through Westchester county in a series of folds with southwesterly trend, and on the northern slope of the Highlands, at several

[1] Continued from p. 425, Vol. VII, JOUR. GEOL.

[2] The Triassic formation of Connecticut, by WM. M. DAVIS: Eighteenth Ann. Rept. U. S. Geol. Surv., Part II, 1898, pp. 1–192. With geological map.

[3] The Structure of the Triassic Formation of the Connecticut Valley, by WM. MORRIS DAVIS: Seventh Ann. Rept. U. S. Geol. Survey, 1888.

[4] The geology of the crystalline rocks of southeastern New York, by F. J. H. MERRILL: Report of the New York State Museum, 1896, pp. 21–44.

places in Dutchess county, are overlain unconformably by quartzites, which are believed to be of Cambrian age.

Ries[1] describes the geology of Orange county, New York. Pre-Cambrian rocks form the Highland region in the eastern part of the county, the northwestern side of Bellvale Mountain, and a series of rounded knob-like hills extending from Sugar Loaf village to Newburgh. They comprise gneiss, at times massive and resembling granite and limestone. The crystalline rocks are folded and faulted, the folds plunging frequently to the northeast.

In the south-central part of the county is found an area of white and blue limestone, which continues south into New Jersey. The white limestone is found in New Jersey to contain fossils of Cambrian age. Exposures are found east of the road, 1¼ miles west-southwest of Pine Island station, which show the passage of the blue into the white limestone. Other, similar areas of limestone are found to the northeast.

Limestones interbedded with the gneisses are found at Popolopen Pond, and again at Fort Montgomery.

Wolff and Brooks[2] present a final discussion of the age of the Franklin white limestone, of Sussex County, N. J. The pre-Cambrian age of the white limestone is believed to be shown by the following facts:

The supposed cases of interbedding of the white limestone and the Cambrian quartzite are found to be due to faulting, or to peculiar conditions of deposition. On the other hand, while it is difficult to prove that the white limestone and pre-Cambrian gneiss are actually interbedded, narrow bands of the true gneiss do occur within the white limestone belt, and seem to be an integral part of the series.

The granite occurring in the area is intrusive in the white limestone, and the nature of the contacts of the granite and the Cambrian quartzite indicates that the intrusion was prior to the deposition of the Cambrian quartzite and blue limestone. While the intrusion of the granite has caused local metamorphism of the white limestone, it is believed that the crystallization of the limestone antedated the granitic intrusion, and was contemporaneous with the crystallization of the gneisses in their present form.

[1] Geology of Orange county, by HEINRICH RIES: Forty-ninth Ann. Rept. of N. Y. State Museum, for 1895, Vol. II, 1898, pp. 395–475. With geological map.

[2] The age of the Franklin White limestone of Sussex County, N. J., by J. E. WOLFF and A. H. BROOKS: Eighteenth Ann. Rept. U. S. Geol. Surv., Part II, 1898, pp. 425–457. With geological map.

The structural relations of the three belts of Cambrian blue limestone with the gneiss and white limestone are such as to indicate unconformity. Along the normal contacts of the blue and white limestone the quartzite intervenes between the two. The bedding of the blue limestone and underlying quartzite is everywhere conformable, while the dip of the foliation of the white limestone and the gneisses is discordant with this bedding.

Isolated patches of Cambrian quartzite are found within the white limestone area. In one place a crevice in the white limestone is filled with the Cambrian quartzite containing undoubted pebbles of the white limestone.

Comment.—The results above presented bear evidence of close and careful field study. The pre-Cambrian age of the white limestone is clearly proven, thus satisfactorily disposing of a much disputed question.

There now remains the question of the origin of the gneisses. In this connection attention may again be called to the marked similarity of the limestones and associated gneisses of the New Jersey area, to the pre-Cambrian limestones and associated gneisses of the Adirondack and Original Laurentian districts to the north. In a general way it would seem that the story worked out for one of the districts may perhaps apply to the others.

Weidman[1] describes the pre-Cambrian igneous rocks of the Utley, Berlin, and Waushara areas, in the Fox River Valley of Wisconsin. They range from volcanic flows to masses of deep-seated origin, with corresponding textures. The rock of the Utley area is a metarhyolite, at Berlin a rhyolite-gneiss, and in the Waushara area a granite. Analyses of the rocks of the three areas show a close similarity in chemical composition, and it is believed that the rocks represent phases of a single parent magma. The rocks have been metamorphosed to different degrees, and the results of the metamorphism, particularly of the feldspars, are described in detail.

The crystalline rocks are unconformably overlain by flat-lying Potsdam and Ordovician sediments. From their similarity in composition to the Baraboo volcanics, which are considered to be of Keweenawan age, it is believed that they belong to the same province, and are therefore of Keweenawan age.

[1] A contribution to the geology of the pre-Cambrian rocks of the Fox River Valley, Wis., by SAMUEL WEIDMAN: Bull. Wis. Geol. & Nat. Hist. Surv., No. III, 1898, pp. 63.

Norton,[1] in a description of the artesian wells of Iowa, discusses the attitude of the Algonkian floor. In the northwestern part of the state the Algonkian outcrops as the Sioux quartzite. From here it sinks rapidly to the south and east, and is discovered near the area of its outcrop only by the steep wells at Sioux City, Hull, and Le Mars. In the east-central part of Iowa is a slight elevation of the Algonkian floor, disclosed by the artesian well at Cedar Rapids. In Wisconsin the Algonkian outcrops as the Baraboo quartzite, a rock similar to the Sioux quartzite. From this outcrop the Algonkian sinks gently to the southwest, as it is reached by the drill at Lansing, Iowa. At no other place in Iowa has the drill gone deep enough to reach the crystalline rocks.

Comment.—The connection of the crystallines reached by the drill with the Algonkian outcrops of Iowa and Wisconsin is conjectural, and perhaps it would be better not to assume that such crystallines are all Algonkian. However, the observations are of interest as showing the attitude of the ancient crystalline floor, whether Archean or Algonkian.

Beyer[2] maps and describes the part of the Sioux quartzite formation exposed northeast of Sioux Falls in sections 10, 11, 14, 15, 22, and 23, T. 102 N., R. 48 W., South Dakota. The quartzite dips from 3° to 7° to the southwest. An accurate estimate of the thickness may not be given, but 1500 feet is a liberal one.

Slate is exposed in the area in isolated outcrops, but never in contact with the quartzite. In composition it corresponds very closely to the quartz-slate of Irving and Van Hise.[3] Intruding the slate are diabase dikes, which have followed the bedding.

The relations of the slates and quartzites cannot here be ascertained. However, from the relations of the two outside of the area it is believed that the slates are the upward continuation of the quartzite, and that they have been removed in large part.

The age of the Sioux quartzite is believed to be pre-Cretaceous. Its reference to the Huronian may be supported by the following facts: The lithological characters of the quartzite are identical with those of

[1] Artesian wells of Iowa, by W. H. NORTON: Geol. Survey of Iowa, Vol. VI, 1897 (The Algokian, pp. 139–140).

[2] The Sioux quartzite, and certain associated rocks, by S. W. BEYER: Iowa Geol. Survey, Vol. VI, 1897, pp. 69–112.

[3] The Penokee iron-bearing series, by R. D. IRVING and C. R. VAN HISE: Tenth Annual Rept. U. S. Geol. Survey, 1890, p. 370 et seq.

the Baraboo quartzite in Wisconsin, which has been referred by Irving and Van Hise to the Huronian. The diabase intruding the slate, supposed to be the upward continuation of the quartzite, is strikingly similar to intrusives which are peculiar to the Huronian in the Lake Superior region.

Frazer[1] sketches the geology of an area in the vicinity of Galena, in the Northern Black Hills of South Dakota. Mica-schists, thought to be upper members of the Archean, are found striking northeast-southwest, and dipping at angles from 38° to 85°. They are generally micaceous and coarse-grained, but vary greatly, sometimes passing into nacrite- or hydromica-schist, and sometimes, though more rarely, assuming a heavily bedded character reminding one of gneiss.

Todd[2] reports on a section across the Black Hills from Rapid City westward. The alternating slate and quartzite beds of the Algonkian were found to be folded in a most intricate fashion. A number of the folds were worked out. In most cases the lamination and stratification seem to correspond in direction.

Comment.—The last observation differs from one made by Van Hise, who, as a result of work done in 1890, concluded that the prominent foliation of the Black Hills is independent of the bedding, and as a rule cuts across it.

Griswold[3] describes the geology of Helena, Montana, and vicinity.

Middle Cambrian, or Flathead, quartzite forms an important part of the ridge stretching from Helena southeast to Montana City, and northwest, west, and south around Mount Helena. The sedimentary rocks underlying most of the area of the city, on the north side of this Cambrian quartzite, are classed as Algonkian. The Algonkian rocks vary from clay-slates to micaceous, sandy, or calcareous slates, which often become quartzites or limestones. The Algonkian slates seem to conform to the overlying strata in the dip of their beds. As there are many small folds, it is difficult to determine the thickness; 5000 feet does not seem too large a total.

Gilbert[4] maps and describes the geology of the Pueblo quadrangle,

[1] Notes on the Northern Black Hills of South Dakota, by PERSIFOR FRAZER: Trans. Am. Inst. Min. Engineers, Vol. XXVII, 1898, pp. 204–228.

[2] Section along Rapid Greek from Rapid City westward, by J. E. TODD: South Dakota Geol. Survey, Bull. No. 2, 1898, pp. 27–40.

[3] The geology of Helena, Montana, and vicinity, by L. S. GRISWOLD: Journal of the Association of Engineering Societies, Vol. XX, 1898, pp. 1–18.

[4] Geol. Atlas of the U. S., Pueblo folio, No. 36, by G. K. GILBERT: U. S. Geol. Survey, Washington, 1897.

including part of Pueblo county and the southeast corner of Fremont county, Colorado. Archean rocks occupy two small tracts in the southwestern part of the quadrangle. The more abundant kinds of Archean rocks are mica-schist, mica-gneiss, and granite. The schists and gneisses strike north to northwest, and are nearly vertical. Their origin is not known. The granite is intrusive in the schists and gneisses.

The Archean rocks are overlain unconformably by Paleozoic and Mesozoic sediments.

Lakes[1] sketches the geology of the Gunnison gold belt in Gunnison county, Col., from the Cebolla River on the west to the head of Taylor Park and the Sawatch range on the east. The northern part of area is included in the granitic system of the Sawatch range. The southern part is occupied by schists and gneisses, underlain by coarse massive granite. The schists and gneisses are of pre-Cambrian age, but whether Algonkian or older has not been determined. The contact of the schists and gneisses with the underlying granite is an eruptive one, the granite containing fragments of the schist, giving the impression that the schists had been floated up on an underlying molten or semi-molten sea of granite. Cutting the schists are occasional dikes of diabase and possibly basalt and andesite, and resting on the eroded edges of the schists are various later overflows of andesitic breccia, rhyolite, trachyte, and basalt.

Aguilera[2] gives a synopsis of the geology of Mexico. The most ancient, or Azoic, rocks are granites, gneisses, and schists, presenting many variations. They extend lengthwise along the Pacific coast, forming a narrow band, interrupted in places, and sending ramifications toward the central part of the country, in some places almost to the eastern coast. They occupy the southern part of the state of Puebla, a part of the Sierra Madre Mountains in Chiapas, and extensive portions of Oaxaca and Guerrero; they are found also in Zacatecas, around Fresnilo; in Guanajuato, in the vicinity of the capital; in Sinaloa, around the crests of the Sierra Madre; in Sonora, in its northwestern and western parts; in lower California, where

[1] Sketch of a portion of the Gunnison gold belt, including the Vulcan and Mammoth Chimney mines, by ARTHUR LAKES: Trans. Am. Inst. Min. Engineers, Vol. XXVI, 1897, pp. 440–448.

[2] Sinopsis de Geologia Mexicana, by JOSE C. AGUILERA: Bol. del Inst. Geol. de México, Nums. 4, 5, & 6, 1897, Part II, pp. 189–250. With geol. maps.

they constitute the central Cordilleran axis of the peninsula; in Vera Cruz, in its western region, limited by Puebla, in the canton of Zongolica.

In the southern part of Puebla, and in Guerrero and Oaxaca, where the greater part of the exposures occur, the sequence is as follows, from the base up: (*a*) Porphyritic gneiss, similar to augen-gneiss, at the base losing its lamination and passing into a kind of granite. (*b*) Phyllite-gneiss, resting upon, and grading below into preceding beds. (*c*) Very abundant mica-schist, in some places garnetiferous, and in perfect conformity with the phyllite-gneisses. (*d*) Phyllites, very argillaceous in the upper part, and showing gradual diminution in the proportion of clay toward the base. In accordance with this change of composition, the structure varies from perfectly schistose to laminated, and finally to stratiform.

After the deposition of the argillaceous phyllites, and before the termination of the Paleozoic, there have occurred numerous eruptions, in order of age as follows: Granite-gneiss, granite, granulite, hornblende granite, pegmatite, greisen, and diorite.

Comment.— The ancient rocks are mapped as Azoic, and in the text are described as Archean and Primitive, so that these three terms are used in the same sense, to cover all rocks below the Paleozoic. The pre-Paleozoic rocks are both sedimentary and igneous, and not improbably may represent the Algonkian as well as the Basement Complex.

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